Summary

Measurement of latent (i.e. not directly observable) variables plays an important role in behavioural science. Behavioural researchers draw inferences about a wide range of variables like mental abilities, attitudes and preferences. Often these inferences are based on tests or questionnaires which consist of items which are assumed to be indicative of the latent variable or 'trait'. Using a scoring rule, the responses of a person to these items are subsequently summarized and/or transformed in a (test) score that is assumed to be related to the 'true' latent score.

A different approach to measurement of latent variables, using the responses from a person to an item, is provided by item response theory. By assuming that persons and items can be respresented by locations on a joint (unidimensional) latent trait and specifying a response relation between them, a measurement model for latent variables is constructed. For the measurement of latent attitudes and preferences a proximity relation is assumed. This relation assumes that agreement of a person with the content of a (proximity) item depends on the person-item distance. The probability of agreement increases for decreasing distance between person location and item location. In parametric models this probability is expressed by a single peaked item characteristic curve (ICC). A number of proximity items ordered by their estimated locations on the latent trait constitute the grid of the measurement model for the assumed latent attitude or preference.

This thesis concerns a study on different aspects of proximity items in the context of the parametric PARELLA model. The ICC's of the PARELLA model are single peaked and are modeled by an item specific location parameter and an overall shape parameter. Marginal maximum likelihood estimation of the parameters of the PARELLA model produces a joint unidimensional representation of item locations and a nonparametric distribution of person parameters. A number of tests and statistics are available to evaluate the fit of the ICC's and the presence of differential item functioning.

A special case of proximity data is studied in which the ICC's of the PARELLA model provide an adequate description of the data but lead to suboptimal measurement properties. The data consist of responses to a number of items that are indicative for the attitude in the 'car-environment' controversy. The items are formulated as either 'against car use' or 'in favour of car use'. Although the assumption of a proximity relation

is reasonable for this latent trait, the reconstructed ICC's do not show a single peaked pattern. Probably due to the bipolar nature of the latent trait the items show a decreasing pattern for the 'against car use' items and an increasing pattern for the 'in favour of car use' items. Closer investigation of the item contents indicates that the PARELLA model produced an intuitive order of the items with the 'against' items located towards the left side of the unidimensional latent trait followed by 'in favour of' items towards the right of the latent trait. The vast majority ($> 90\%$) of the persons are located to the right of the last 'against' item and to the left of the first 'in favour of' item. The absence of (moderate) items that discriminate the majority of person results in poor measurement properties of the instrument. Considering the 'issue'-like nature of the latent trait it is questionable whether more moderate items can be constructed. It is also questionable whether the single peaked ICC's provide the flexibility needed for modelling these data. The ICC's that are imposed on these data are only flexible with respect to the item location and an overall shape value and not with respect to an item specific shape, height and width. To accommodate the observed 'reconstructed' ICC's an extended OPLM model is applied to these data, in which the ICC's are allowed to be either decreasing or increasing. The extended OPLM model produced an adequate fit with improved measurement properties.

The decreasing and increasing ICC's that are observed for an attitude in an issue-like context indicate that other aspects besides item location are theoretically relevant for single peaked ICC's. These aspects concern the shape (as incorporated in the PARELLA model), the height and the width of the single peaked ICC. The height of a single peaked ICC can be regarded as an indication of the maximum choice probability of a person responding to an item. This choice probability is maximal for zero distance between person location and item location. The width of an item theoretically differs for items depending on the range of the latent trait where the item is positively evaluated. Both the height and the width of an ICC can be incorporated as parameters in a single peaked model. In a study on the flexibility of single peaked models the PARELLA model, the simple squared logistic model, the hyperbolic secant function, the hyperbolic cosine model and a model based on the normal curve, are extended to four item specific parameters. The ICC's of these extended four parameter models are compared in their flexibility to model some predetermined ICC's. The comparison of the extended models indicates that by manipulation of the parameter values all models can be made to conform to the predetermined ICC's. This comparison study demonstrates that by incorporating additional parameters the models can be made equally flexible in modelling a single peaked response process.

Modelling an ICC with more than one item specific parameter, although theoretically relevant, will be problematic when estimates have to be obtained from actual data. Previous research indicates that identification problems can be expected when, additional

to the location parameter, other item specific parameters are estimated from the data. A feasibility study, in which the pairwise correlations between the parameter estimates are determined, demonstrates that straightforward estimation will be increasingly problematic when the number of item specific parameters of the PARELLA model increases. Dependencies like a strong correlation between the estimates of the location and the width (of the same item) indicate that different values for both parameters will render roughly the same likelihood value. These dependencies indicate that application of a PARELLA model that is extended to two, three or four item specific parameters wil be problematic and for some extensions even impossible.

To circumvent identification and optimization problems for the extended PARELLA model, an estimation procedure is proposed in which the values of the item specific shape and width parameters are restricted to three predetermined (i.e. smal, medium and large) values. For this PAR3b model the values for the item locations are estimated from the data with the values for the other parameters inserted in the likelihood function. Lagrange multiplier tests on the postulated values of the shape and the width indicate whether the parameter is correcly specified or needs adjustment. A simulation study indicates that the proposed estimation procedure functions adequately with small loss in terms of likelihood and large gain in terms of interpretability of the model and avoidance of estimation problems.